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## (54) Abrasive tools

Abrasive Werkzeuge

Outils abrasifs

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## Description

### BACKGROUND TO THE INVENTION

THIS invention relates to abrasive tools.

Abrasive tools are known that comprise a body in which are mounted inserts which have a wear-resistant or abrasive layer. It is this layer that is used to perform a cutting or abrading action. The support for the wear-resistant layer may be in the form of a post of squat proportions. It is the mounting of the post in the working face of the tool body that can present problems to the manufacturer and the user. Until now, such posts have been secured to the body by providing a suitable complementally shaped recess or socket in the working face, locating the post therein and brazing the post to the sides of the socket or recess by means of a suitable braze alloy. Most commonly, the post and the recess are cylindrical.

A disadvantage of this method is that residual stresses are induced at the circumferential region of the post at the area where maximum bending stresses also arise in use. These stresses are of the same order of magnitude as the strength of the braze alloy.

Another disadvantage is that the high temperatures required in the brazing cycle tend to cause deterioration of the post, which is usually made of a carbide. and also of the abrasive layer. This is especially so when the abrasive layer is composed of a diamond composite that is not thermally stable.

It may also happen that the impacts to which the tool are subjected in use may cause sufficient rise in temperature to lead to melting of the braze and consequent failure of the bond.

Another method has been to shrink fit the post so that it is mechanically held in the recess or socket. The socket may be suitably tapered with its cross section decreasing with increasing depth into the body.

US-A-3 749 190 discloses a rock drill bit having tapered carbide buttons projecting from its working face in which the buttons are retained in the bit by means of sleeves which are extruded into undercuts of the button holes and retain the carbide buttons in the drill bit by virtue of the shear strength of the sleeves.

### SUMMARY OF THE INVENTION

The present invention provides an abrasive tool comprising a body having a working face, at least one recess in the body extending to the working face, the recess including an undercut provided at a localised position in the depth of the recess, and a cutting insert having a post located within the recess and a working end carried by the post and extending beyond the working face, characterised in that:

- the post of the cutting insert, within the recess, has a cylindrical portion and, at a localised position along the length of the post within the recess, a projection extending laterally outwardly from the cylindrical portion, the projection being aligned with the undercut of the recess and a space being defined between the projection and the undercut. and

- a deformable locking insert deformed into the space so to engage between the projection and the undercut thereby to lock the cutting insert against withdrawal from the recess.

In one preferred embodiment, the undercut is conically shaped, the cutting insert has a conically shaped foot portion received in the undercut and the locking means comprises a tubular sleeve forced into a position of engagement between the undercut and the foot.

In another embodiment, the cutting insert includes a relatively enlarged waist, the recess includes an annular undercut and the locking means comprises a tubular sleeve forced into a position of engagement between the undercut and the waist.

In yet another embodiment, the cutting insert includes a laterally projecting portion, the recess includes a lateral enlargement and the locking means comprises a strip insert forced into a position of engagement between the laterally projecting portion and the lateral enlargement. In this case, the recess may include a groove in its side wall serving as a keyway for the laterally projecting portion of the cutting insert.

Each of the embodiments summarised above may comprise anti-rotation means to prevent rotation of the cutting insert in the recess. Typically, the anti-rotation means comprises a key on the cutting insert and a keyway in the recess, or vice-versa.

### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying

drawings.

In the drawings:

**Figures 1a and 1b** show exploded and assembled sectional side views respectively of a portion of an abrasive tool of the invention;

**Figure 2** illustrates a second embodiment of the invention in a partially exploded view;

**Figures 3a and 3b** show views corresponding to those of Figure 1 but of a third embodiment of the invention;

**Figures 4a and 4b** show views corresponding to those of Figure 1 but of a fourth embodiment of the invention; and

**Figure 4c** shows a view looking in the direction of the arrow in Figure 4b.

## DESCRIPTION OF EMBODIMENTS

This invention has particular application to drill bits wherein the inserts are studcutters. The studcutter may be any one of various shapes in cross section, including but not limited to square, oval or rectangular or even combinations thereof.

The working end may be of various shapes from flat cylindrical to oval or bullet-shaped and may contain indentations or be discontinuous.

The recesses shaped to accommodate the studcutter may be cast in the working surface of the drill crown or may be machined using a dovetail cutter in a milling machine, such as a CNC (computer numerically controlled) milling machine. Alternatively, round undercut holes may be made with a conventional adjustable boring head fitted to any suitable milling machine.

A first embodiment of the invention will now be described with reference to Figures 1a and 1b of the drawings.

With reference to Figure 1a, the working face 10 of a drill crown contains a recess 12 which has been undercut to form a flared, in this case conically shaped portion 14 of expanded cross section. At the working face 10, the recess 12 has a diameter of dimension d. A studcutter 16 has a post with a cylindrical portion 18, carrying an abrasive working end 20, and a conically shaped foot 22 at the other end. The diameter of the foot is no larger than the diameter d and is preferably slightly less.

In assembling the drill bit, the studcutter 16 is located in the recess 12, foot first, so that the foot 22 locates in the flared portion 14 of the recess. It will be noted that the relative dimensions of the recess and of the studcutter post are such that a vacant space is left between the studcutter post 18 and the walls 26 of the recess.

Thereafter, a deformable sleeve 24 is positioned around the studcutter and is forced axially into the recess 12. With the application of sufficient force, the lower portion of the sleeve 24 is caused to expand around the foot 20 of the studcutter. In practice, force is applied to the sleeve by means of a tubular punch which presses against the upper edge of the sleeve and drives the sleeve in a direction into the recess 12.

To facilitate expansion of the lower portion of the sleeve 24, saw cuts 28 are formed in the wall of the sleeve from its leading end 30. The sleeve material will typically be a relatively pliable material such as mild or stainless steel or a plastics material, so that it can be made to deform in a manner to conform to the shape of the space existing between the wall of the recess and the studcutter post.

The studcutter assembly is shown in assembled form in the working face of the drill bit in Figure 1b. The lower portion of the sleeve 24 has expanded to surround the foot 22 of the studcutter 16 and occupy the undercut, flared portion 14 of the recess 12.

In this position, the sleeve 24 serves to lock the studcutter in the working face 10 with its working end 20 exposed and standing proud of the working face. Any force exerted applied to the studcutter in a direction to pull it from the drill crown will result merely in forces, indicated by the arrows in Figure 1b, being applied to the wall of the recess. The wall 26 exerts opposing forces on the studcutter and sleeve, thereby locking them in position in the recess.

The studcutter secural method illustrated by Figures 1a and 1b was tested in the laboratory for impact and torque resistance. The test for impact resistance was performed using a standard Izod impact tester made by Avery. Using the Izod tester, a pendulum-suspended impactor chisel was swung transversely so as to impact against the upstanding portion of the studcutter post. In each case, the studcutter post was machined to have a flat surface against which the corresponding flat surface of the impactor chisel could strike fully. The pendulum was given 300J of kinetic energy for each blow against the cutter post.

Three conventional brazed assemblies were tested alongside four assemblies according to Figures 1a and 1b and measurements were made of the energy required to break the studcutter post. The post of the three conventional assemblies broke on absorption of 18J, 22J and 23J respectively. Of the four assemblies of the present invention, two

of the posts fractured at 47J and 110J respectively. Even though impacted twice, the other two posts could not be broken at all, indicating that these posts could twice absorb the full 300J of available energy without fracture.

Overall it was clear that studcutter posts secured in accordance with the technique proposed in Figures 1a and 1b showed a far higher impact resistance than the conventionally brazed studcutter posts.

Torque resistance tests were performed using a torque wrench with a suitable adaptor to engage the studcutter post, and measurements were made of the torque required to rotate the post in its mounting.

In a test on a conventionally brazed studcutter post, no rotation was observed at a torque of 450Nm. In a corresponding test on a studcutter post mounted in accordance with Figures 1a and 1b, rotational slippage was observed at 140Nm. This indicated the desirability of anti-rotation devices in the technique of Figures 1a and 1b if high levels of torsional resistance are considered necessary.

A second embodiment of the invention is shown in Figure 2. In this case, the studcutter 16 has a post 18 with an end section 22 and a reduced diameter neck section 32. In practice, the illustrated shape is achieved by appropriate machining of the cylindrical post of a conventional bullet-shaped studcutter. Collets 34 are secured to the post 18 in the region of the neck section and create a flared foot for the post as illustrated. The collets may be secured in the illustrated positions by means of a suitable adhesive.

The embodiment of Figure 2 is then secured in a recess in the working face of a tool by means of a sleeve like the sleeve 24 used in the first embodiment. As before, the studcutter is therefore locked against withdrawal from the recess. Once again, it is anticipated that anti-rotation measures will be required if high levels of torsional resistance are to be provided.

A third embodiment of the invention is illustrated in Figures 3a and 3b. Referring to these Figures, the post of a studcutter 40 has a thickened waist portion 42 between its end 44 and the abrasive working end 46. The recess 48 in the working face 50 of a drill bit has a similar shape.

In use, the studcutter post is inserted into the recess 48 and an expandable sleeve 52, similar to the sleeve 24 of the first embodiment, is then forced into position around the post 40 and the thickened waist portion 42 to lock the studcutter post in the recess.

As in previous embodiments, it is expected that anti-rotation measures will be necessary if high levels of torsional resistance are to be provided.

A fourth embodiment of the invention is illustrated by Figures 4a, 4b, and 4c. Referring to these Figures, a studcutter 60 has a post 62 having an abrasive working end 64. Close to the opposite end 66 is a projection 68. A recess 70 formed in the working face 72 of a drill bit includes an enlargement or "bubble" 74 formed at its lower end. The bubble 74 is shaped to accommodate the projection 68 on the post 62. A groove 76 extends from the working face 72 to the bubble 74.

In use, the studcutter post 62 is inserted into the recess 70. During the insertion process the groove 76 acts as a keyway to guide the projection 68 into the bubble 74. Thereafter a strip insert 78 is forced down the groove 76 and around the projection 68, as shown in Figure 4b, to lock the studcutter post in the recess.

In this embodiment, the engagement between the projection 68 and the bubble 74, via the insert 78, acts to prevent rotation of the studcutter post in the recess. Thus this embodiment can be expected to have a higher torsional resistance than the earlier embodiments.

It will be appreciated that it would be a simple matter to include an anti-rotation device of the type illustrated in Figures 4a to 4c in the embodiments described previously, or in fact other anti-rotation measures, if high levels of torsional resistance are necessary in a particular application.

Note that the exposed top surface of the sleeve or strip in the relevant embodiments can be provided with an abrasive protective layer. Note also that the abrasive working end of each cutting insert is preferably provided by a diamond compact.

## Claims

1. An abrasive tool comprising a body having a working face (10, 50, 72), at least one recess (12, 48, 70) in the body extending to the working face, the recess including an undercut (14, 74) provided at a localised position in the depth of the recess, and a cutting insert (16, 40, 60) having a post located within the recess and a working end (20, 46, 64) carried by the post and extending beyond the working face, characterised in that:

   - the post of the cutting insert, within the recess, has a cylindrical portion and, at a localised position along the length of the post within the recess, a projection (22, 34, 42, 68) extending laterally outwardly from the cylindrical portion, the projection being aligned with the undercut (14, 74) of the recess and a space being defined between the projection and the undercut, and

- a deformable locking insert deformed into the space so to engage between the projection (22, 34, 42, 68) and the undercut (14, 74) thereby to lock the cutting insert against withdrawal from the recess.

2. An abrasive tool according to claim 1 characterised in that the undercut (14) is conically shaped, the post of the cutting insert (16) has a conically shaped foot portion (22) aligned with the undercut (14), and the locking insert comprises a tubular sleeve (24) forced into a position of engagement between the undercut (14) and the foot portion (22).

3. An abrasive tool according to claim 1 characterised in that the post of the cutting insert (40) includes a relatively enlarged waist (42) at a localised position along the length of the post within the recess (48), the recess includes an annular undercut at a localised position along its depth, and the locking insert comprises a tubular sleeve (52) forced into a position of engagement between the undercut and the waist.

4. An abrasive tool according to claim 1 characterised in that the post of the cutting insert (60) includes a lateral protrusion (68) at a localised position along the length of the post within the recess (70), the recess includes a lateral enlargement (74) at a localised position along its depth, and the locking insert comprises a strip (78) of deformable material forced into a position of engagement between the lateral protrusion (68) and the lateral enlargement (74).

5. An abrasive tool according to claim 4 characterised in that a side wall of the recess (70) includes a groove (76) extending along the depth of the recess and serving as a keyway for the lateral protrusion (68) of the cutting insert (60).

6. An abrasive tool according to claim 1 characterised in that it comprises anti-rotation means (68, 74, 76) to prevent rotation of the cutting insert (60) in the recess (70).

7. An abrasive tool according to claim 6 characterised in that the anti-rotation means comprises a key (68) on the cutting insert (60) and a keyway (76) in the recess (70).

8. An abrasive tool according to claim 2 or claim 3 characterised in that the sleeve (24 or 52) has a tubular wall with slots (28) formed in one end thereof.

9. An abrasive tool according to claim 4 characterised in that the sleeve (24) has a tubular wall with slots (28) formed in one end thereof.

10. An abrasive tool according to any one of the preceding claims characterised in that the tool is a drill bit.

**Patentansprüche**

1. Abtragwerkzeug mit einem eine Arbeitsfläche (10,50,72) aufweisenden Körper, mindestens einer in dem Körper ausgebildeten, sich zu der Arbeitsfläche erstreckenden Vertiefung (12,48,70) mit einem hinterschnittenen Bereich (14, 74), der in einer örtlichen Position im unteren Bereich der Vertiefung ausgebildet ist, und einem Schneid-Einsatz (16,40,60) mit einem innerhalb der Vertiefung angeordneten Schaft und einem Arbeitsende (20,46, 64), das von dem Schaft gehalten ist und über die Arbeitsfläche vorsteht, dadurch gekennzeichnet, daß

   - der Schaft des Schneid-Einsatzes innerhalb der Vertiefung einen zylindrischen Abschnitt und an einer örtlichen Position entlang der Länge des Schaftes innerhalb der Vertiefung einen Vorsprung (22,34,42,68) aufweist, der seitlich von dem zylindrischen Abschnitt nach außen absteht, wobei der Vorsprung mit dem hinterschnittenen Bereich (14,74) der Vertiefung ausgerichtet ist und zwischen dem Vorsprung und dem hinterschnittenen Bereich ein Raum gebildet ist, und

   - ein verformbarer Verriegelungs-Einsatz unter Verformung derart in dem Raum angeordnet ist, daß er zwischen dem Vorsprung (22,34.42.68) und dem hinterschnittenen Bereich (14,74) angreift, um dadurch den Schneid-Einsatz gegen ein Herausziehen aus der Vertiefung zu verriegeln.

2. Abtragwerkzeug nach Anspruch 1, dadurch gekennzeichnet, daß der hinterschnittene Bereich (14) konisch ausgebildet ist, der Schaft des Schneid-Einsatzes (16) einen konisch geformten Fußabschnitt (22) aufweist, der mit

dem hinterschnittenen Bereich (14) ausgerichtet ist, und der Verriegelungs-Einsatz eine rohrförmige Hülse (24) aufweist, die in eine Eingriffsposition zwischen dem hinterschnittenen Bereich (14) und dem Fußabschnitt (22) gedrückt ist.

3. Abtragwerkzeug nach Anspruch 1, dadurch gekennzeichnet, daß der Schaft des Schneid-Einsatzes (40) an einer örtlichen Position entlang der Länge des Schaftes innerhalb der Vertiefung (48) einen relativ erweiterten Bauch (42) aufweist, die Vertiefung an einer örtlichen Position entlang ihrer Tiefe einen ringförmigen hinterschnittenen Bereich aufweist und der Verriegelungs-Einsatz eine rohrförmige Hülse (52) aufweist, die in eine Eingriffsposition zwischen dem hinterschnittenen Bereich und dem Bauch gedrückt ist.

4. Abtragwerkzeug nach Anspruch 1, dadurch gekennzeichnet, daß der Schaft des Schneid-Einsatzes (60) an einer örtlichen Position entlang der Länge des Schaftes innerhalb der Vertiefung (70) einen seitlichen Vorsprung (68) aufweist, die Vertiefung an einer örtlichen Position entlang ihrer Tiefe eine seitliche Erweiterung (74) aufweist und der Verriegelungs-Einsatz einen Streifen (78) aus einem verformbaren Material aufweist, der in eine Eingriffsposition zwischen dem seitlichen Vorsprung (68) und der seitlichen Erweiterung (74) gedrückt ist.

5. Abtragwerkzeug nach Anspruch 4, dadurch gekennzeichnet, daß eine Seitenwand der Vertiefung (70) eine Nut (76) aufweist, die in Richtung der Vertiefung verläuft und als eine Keilnut für den seitlichen Vorsprung (68) des Schneid-Einsatzes (60) dient.

6. Abtragwerkzeug nach Anspruch 1, gekennzeichnet durch eine Drehverhinderungseinrichtung (68,74,76) zum Verhindern einer Drehung des Schneid-Einsatzes (60) in der Vertiefung (70).

7. Abtragwerkzeug nach Anspruch 6, dadurch gekennzeichnet, daß die Drehverhinderungseinrichtung einen an dem Schneid-Einsatz (60) ausgebildeten Vorsprung (68) und eine in der Vertiefung (70) ausgebildete Keilnut (76) aufweist.

8. Abtragwerkzeug nach Anspruch 2 oder Anspruch 3, dadurch gekennzeichnet, daß die Hülse (24 oder 52) eine rohrförmige Wand aufweist, in deren einem Ende Schlitze (28) ausgebildet sind.

9. Abtragwerkzeug nach Anspruch 4, dadurch gekennzeichnet, daß die Hülse (24) eine rohrförmige Wand aufweist, in deren einem Ende Schlitze (28) ausgebildet sind.

10. Abtragwerkzeug nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Werkzeug ein Bohrmeißel ist.

**Revendications**

1. Outil abrasif comprenant un corps avec une face de travail (10, 50, 72), au moins un évidement (12, 48, 70) dans le corps s'étendant jusqu'à la face de travail, l'évidement comprenant une contre-dépouille (14, 74) ménagée en une position localisée dans la profondeur de l'évidement, et un insert de coupe (16, 40, 60) avec un axe situé à l'intérieur de l'évidement et une extrémité de travail (20, 46, 64) portée par l'axe et s'étendant au-delà de la face de travail, caractérisé en ce que :

   - l'axe de l'insert de coupe, à l'intérieur de l'évidement, présente une portion cylindrique et, en une position localisée sur la longueur de l'axe à l'intérieur de l'évidement, une saillie (22, 34, 42, 68) s'étendant latéralement vers l'extérieur à partir de la portion cylindrique, la saillie étant alignée sur la contre-dépouille (14, 74) de l'évidement et un espace étant défini entre la saillie et la contre-dépouille, et
   - un insert de blocage déformable déformé dans l'espace de façon à s'engager entre la saillie (22, 34, 42, 68) et la contre-dépouille (14, 74) permettant ainsi de bloquer l'insert de coupe pour empêcher son extraction de l'évidement.

2. Outil abrasif selon la revendication 1, caractérisé en ce que la contre-dépouille (14) est de forme conique, l'axe de l'insert de coupe (16) présente une portion de pied conique (22) alignée sur la contre-dépouille (14) et l'insert de blocage comprend un manchon tubulaire (24) forcé en position d'engagement entre la contre-dépouille (14) et la portion de pied (22).

Fig 4a

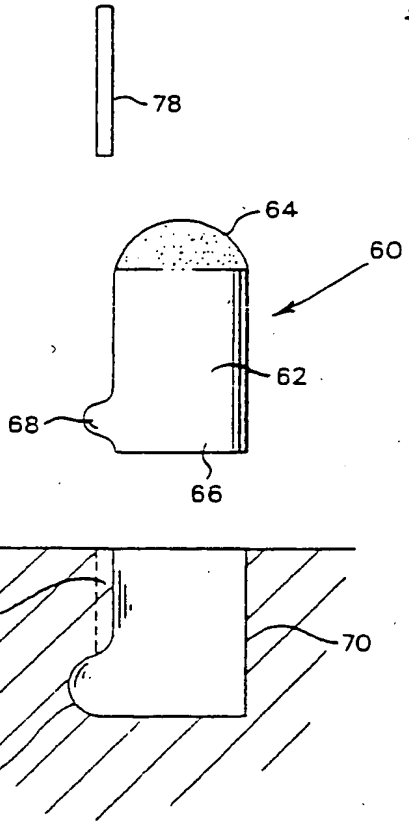
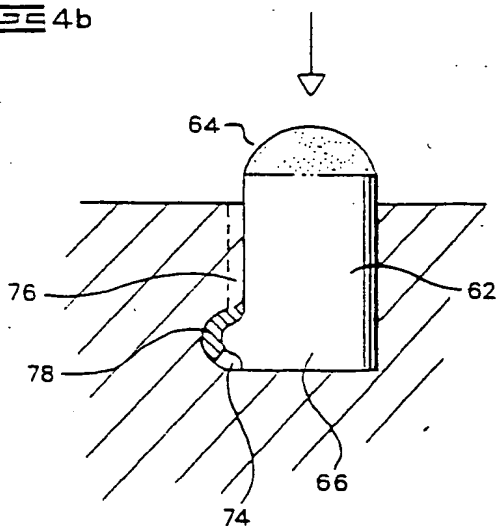



Fig 4b



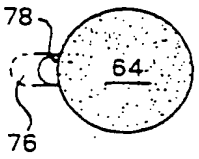
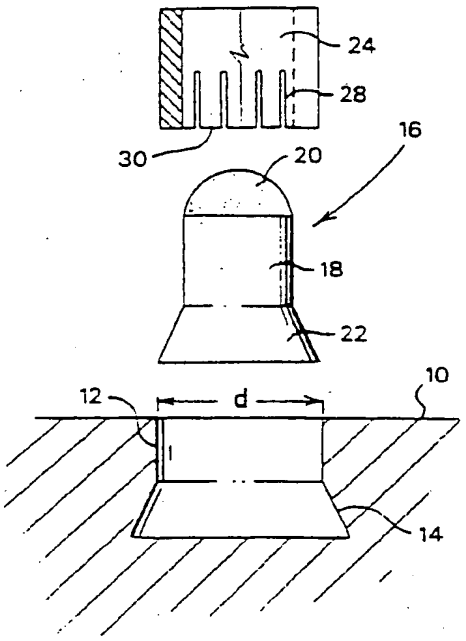




Fig 4c

Fig 1a



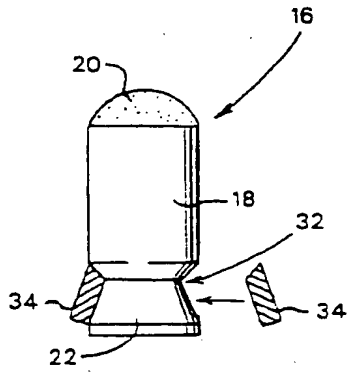




Fig 2

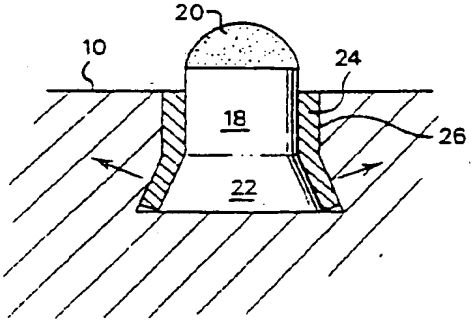



Fig 1b


Fig 3a

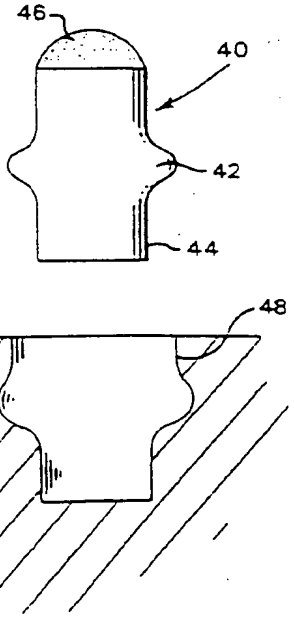



Fig 3b